CLAIM 0

I , Russell Davis, claim as my invention "An Integrated System for Shellfish Production".

My invention, "An Integrated System of Shellfish Production", is derived from my original design design process and paradigm which is a broadly scoped variation of the simplex optimization algorithm. The scope of iteration is unique to this invention. For each node (step, stage, or obstacle) in the process an enumeration was made of the physiological or behavioral strategies that were used by some species or community of species to address the node; an array of devices to emulate each node/strategy was made and a marginal contribution (= marginal revenue minus marginal cost) assigned to each node/strategy/device on a range of implementation scales; then the whole system of 'equations' was reevaluated according to the marginal contribution of each node/strategy/device/scale. The contribution margin of each node faces a subsequent cascade of constraints at each node along the production process. As each node is optimized another node becomes most significant in turn. Sometimes after a node is optimized its cost is such that the most cost significant node in the next step is a predecessor of the current node rather than a subsequent and the optimization process recurses. Sometimes that recursion only occurs at a particular scale or species. Sometime that repercussion was only possible if a new objective or market for shellfish production was introduced, such geophysical feature development or breeding for flexible immune competencies under environmental variation.

My processing of the algorithm was as disciplined as possible for me to achieve – it might be best described as eight years of diligent rumination on an ever expanding problem domain within the context of shellfish culture.

To my surprise, on the edges of that rumination I have found that the ruling geophysical constraints to shellfish production were more political than innately geophysical or biological. Even these constraints can be relaxed and are address by devices in this invention. The political,

legal and markets structure aspects of shellfish production have increasingly risen as bounds to my exploration of the problem domain. As much as that is true the rumination is well-bounded enough for the invention of the "Integrated System of Shellfish Production" to be patented as a unified whole.

The claimed features of the invented integrated system are not independent inventions subject to patent division but are connected by "*design, operation, and effect*" and the "*claims are linked to form a single innovative concept*".

The reiterative, once-more-around-lightly to get the high spots after a refreshed enumeration of options, approach of the design algorithm influences the presentation style of this patent application also. Anticipating that spiral down, across and through the particulars of the system devices with occasional recurse will make the topic transitions less jarring and allow for a better understanding of the context, construction and purpose of any particular device in the system. Such a large advance in an industry as presented by this patent is bound to be attended with considerable cognitive dissonance in the first reading- please accept my apologies and gratitude for any suspension of judgment until understanding is achieved.

The process/device of Claims 1, 2, 3, 4, 5, 7, 8, 9, 16 and 31 within the Integrated System emulate the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. The process/device of claim 8 device additionally emulates the current management strategy and configuration of a soft coral called the sea pen or sea plume. These evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable designs by the process of Claim 0.

The devices of Claims 16 and 33 within the Integrated System that emulate the marsupium of larvipaous (ovolarviparous) shellfish. That evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable designs by the process of Claim 0.

The devices of Claims 23, 32, 34, 35 and 36 are needed to implement the device of claim 33.

The device of Claim 23's design was inspired by the mangrove tree propagule and the stinging nettles nematocyst. Those evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

The device of Claim 32's and Claim 36'6 design was inspired by an egg raft that was probably produced by the marsh grass snail, *Littorina irrorata.* That evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

The device of Claim 34's design was inspired by the 'rafting' behavior sometimes displayed by planktonic shellfish veligars in which the veligars appear to act as a school and form a vortex by their concerted motion that appears to act as a pump so that they might harvest more plankton from more water than the could achieve by individual action alone. This rafting behavior is not continuous and may occur only when food density drops or the oxygen gradient in the water makes the air-water interface hugging and surface water harvesting behavior advantageous. That evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

The device of Claim 21 is needed to implement the device of Claim 32.

The process/devices of Claims 37 and 38 allow humans to emulate ways in which shellfish modify their environment so that the shellfish become even more prosperous and resilient to misfortunes of weather. Those evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable designs by the process of Claim 0.

The Claim 17 process/device gives humans the ability to emulate ways in which weather and marine life reworks fine sediment in ways that are advantageous to the shellfish's health and prosperity. That evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

The Claim 24 process/device gives humans the ability to emulate ways in which the benefits of shellfish exposure to atmospheric exposure may be had while avoiding the detriments of atmospheric exposure. That arbitrage of conditions was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

The Claim 39 process/device remedies the pattern in estuary canal building where shore-margin construction creates environmental niches the are initially very attractive to shellfish yet the burst of vitality (which is highly valuable to the property owners) is naturally unsustainable and that has produced much in the way of counter productive blame making. Claim 39 is the result of the "Integrated System of Shellfish Production" constraint discovery and management. One of those constraints is political. The history of blame-laying without knowledge has made many waterfront land owners fearful of shellfish production. This must be changed for the implementation not to be hindered politically. Rapport and trust must be established with its neighbors on the waterfront. This is essential and integral to the successful implementation of the "Integrated System of Shellfish Production". Boundless ecological enhancement and restoration and the removal of causes for false blaming is the good neighbor strategy needed to achieve that rapport. The canals present many square feet of very desirable and scarce structural niches whose ecological value and vitality has been limited by transient moments of low oxygen and water flow. The invention of claim 39 acts to consistently remove that transient constraint for those canal owners that wish to do so. If any chose to do so, the "stickiness" in the blame on the remainder will diminish. Hopefully, this demonstrated willingness to be a good and useful neighbor will win many good neighbors in return. This claim addresses a distinct yet integral product of this "Integrated System of Shellfish Production". Outside of the context of the "Integrated System of Shellfish Production"s need for neighborliness the claim has insufficient economic value and the invention would be lost as no one has enough economic incentive to offer and publish the product.

The process/devices of Claims 10, 11, 18 and 19 address the terra-forming products of the integrated system of shellfish production. These claims address distinct yet integral products that cannot exist outside of the contest provided by the orders of magnitude increase in productivity within this "Integrated System of Shellfish Production". The economic niche for the device/process of these claims was declared by the marginal cost analysis of the design paradigm which gave those marginal costs a context.

The process/device of Claim 22 intensifies the existing selection strategies of shellfish by amplifying the geochemical detriments to the shellfish immune strategies. Those c-lectin and mucus based strategies have been suitable for the geologically recent past but given the increased concentration of atmospheric carbon dioxide, increase frequency of storm sized waves in the summertime and increased shoreline erosion due to rising sealevels, greater flexibility in immune strategies will be needed by the shellfish if they are to prosper in these otherwise suitable niches. Claim 22's process device raises that challenge and selection pressure to match the increased breeding productivity and resulting opportunities for selecting from great genetic diversity. Without the context of the "Integrated System of Shellfish Production" where it is reasonable to manage a twenty-five billion veligar spawn, increasing larval selection pressure to the point where only one in one million survive would be equivalent to killing all the larvae. This selection process only has value within the context and breeding capacity achieved within the "Integrated System of Shellfish Production". The significance of the marginal costs reduced in the design would not have be so thoroughly processed if it were not for the discipline of the design algorithm of Claim 0.

The process/device of Claim 20 is the functional inverse of the process/device of Claim 22 and is integral to the system in its market and broodstock conditioning phases. Claim 20 would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

The process/devices of Claims 12,13, 14, 15 and 29 addresse the needs integral to the "Integrated System of Shellfish Production" where the high number of shellfish at a high density requires an inexpensive method of supplementing shellfish feed and enhancing the immune competence of the shellfish. If these distinct features where removed from the system the shellfish grown in it would face a greater risks of starvation stress and disease. Moreover the great number of shellfish coming to market from the system would tend to crash the market unless their quality was known to be greater than that from conventional production. The features offered to the "Integrated System of Shellfish Production" by these claims, and Claim 6, are so essential, integral, and distinct that the "Integrated System of Shellfish Production" would likely be a financial failure without them. These claims would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

The process/devices of Claims 25, 26, 27, 28 and 30 enable the "Integrated System of Shellfish Production" to be integrated with the culture of a symbiotic cohort of species to effect great economy and convenience that cannot be achieved without that Integration. Moreover the swam spawning enabled by the process device of Claim 31 and 33 would be much less economic and have much greater capital requirements and much greater risk to that capital without the integration of Claims 25, 26, 27, 28 and 30 into the "Integrated System of Shellfish Production". These claims would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

CLAIM 1. I claim as my invention a shellfish nursery stock container consisting of two framed mesh sheets fastened together and sometimes spaced apart by a combination of shims (mesh,

solid and/or compressible) such that the depth of the frame is adjustable to both accommodate the shellfish growth and hold the shellfish so they will not be overly jostled by high flows of water. (Figure 3) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 2. I claim as my invention a shellfish growing device (FLUPSY) with a pivoting vane used to obstruct and bind a flow of water such that it is forced up through a separate mesh frame which contains shellfish. The pivoted vane accommodates a change in the tidal flow direction. (Figure 1) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 3. I claim as my invention a shellfish growing device (FLUPSY) with the ability to work while moored in series, bow to stern. This is accomplished by having water exit on the sides above the bottom plain of the mesh shellfish container and sometimes aided by an approximately upright panel perpendicular to the current to block the flow of water above the bottom plain of the mesh shellfish container at either bow or stern of the FLUPSY. This prevents the exit water of an up-current FLUPSY from pressing down upon the exit water of the next FLUPSY in the series. Sometimes Descending side panels extend below the mesh shellfish container to inhibit the exit water from flowing down into the intake of next FLUPSY. (Figure 1) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 4. I claim as my invention a shellfish growing device (BUPSY) with a pivoting mesh container (not a separate vane) used to obstruct and bind a flow of water such that it is forced through the mesh frame which contains shellfish. The pivot accommodates a change in the tidal flow direction. (Figure 2) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 5. I claim as my invention a shellfish growing device, a TWWELLER (Two Way upweller/downweller) with opposing flexible scoops opening on both the up-estuary and down-estuary moored ends of the device. The shellfish are placed in a roughly horizontal mesh container between the two scoops. On the changing of the tide the scoop that was an inbound scoop becomes an outbound cowling and the flow through the mesh changes direction so the mesh and scoop/cowls will tend to clear themselves of fouling – the device oscillates between up-weller and down-weller with the change in tide. (Figure 11) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 6. I claim as my invention the premarket hypersaline treatment of marine products (feed ingredient products and human consumption products) to enhance the production of osmoregulator chemicals . These osmoregulator chemicals are sometimes useful for enhancing flavor and provide evolution based feeding cues to a wide variety of species. This behavior was functionally decomposed and reconstructed as a product enhancement strategy by the process of Claim 0.

CLAIM 7. I claim as my invention a water filtering device in which small fish and crustaceans that are captured between the filter panels such that they must clean the mesh panels or starve.

This device and cohort emulates the self cleaning behavior of the marsupium used in freshwater mussel reproduction. See Figure 18 This process/device also emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 8. I claim as my invention a device, a BUPSY or bottom upweller device, consisting of a mesh envelope, that has an opening along one edge, that has a strong-back and closure device bound to that opening edge. The strong-back is given floatation sufficient to buoy the assembly and the shellfish contained therein. The assembly is anchored so that it may maintain a position just off the bottom with the strong-back horizontal and normal to the usual current. See Figure 17 This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This process/device additionally emulates the current management strategy and configuration of a soft coral called the sea pen or sea plume. These evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable designs by the process of Claim 0.

CLAIM 9. I claim as my invention a grounding tolerant current capturing device that is able to clear itself of incoming sediment, and commonly experienced debris and vegetation. The device is a scoop of flexible fabric. Sometimes the scoop has portions of its small end left open so that a portion of the captured water will exit the scoop in an accelerated fashion carrying the debris and sediment with it. Since the scoop is flexible the scoop may touch bottom with much lower probability of damage and operational disruption. Moreover when the scoop using assembly needs to be relocated it may be pulled through the water by the small end of the device so that the flexible scoop will be collapsed by the water pressure and reduce resistance to movement through the water. (Figure 13) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater

pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 10. I claim as my invention a device and process that maintains and develops water channels by means of an array of foils that direct and accentuating natural bottom scour and transport in the desired direction and inhibits scour and transport in the undesired direction. See Figure 19 The process/devices is a terra-forming product of the integrated system of shellfish production. The process/device would not be proportionally significant to sediment transport outside of the context provided by the orders of magnitude increase in hatchery productivity within this "Integrated System of Shellfish Production". The economic niche for the device/process of this claim was declared by the constraint analysis of the design paradigm of Claim 0.

CLAIM 11. I claim as my invention the shellfish reef geo-structures constructed from salt marsh and netting reinforcement. See Figure 16 The process/devices is a terra-forming product of the integrated system of shellfish production. The process/device only has a high probability of ultimate success within the context provided by the orders of magnitude increase in hatchery productivity within this "Integrated System of Shellfish Production". The economic niche for the device/process of this claim was declared by the marginal cost and constraint analysis of the design paradigm of Claim 0.

CLAIM 12. I claim as my invention a soup made from cooked seaweeds as a nutrient and water conditioner for filter feeding shellfish and phytoplankton. The role of seaweed exudate was functionally decomposed and reconstructed as a product by the process of Claim 0.

CLAIM 13. I claim as my invention the "Seaweed Soup" feed for shellfish to ensure their table quality and guarantee that the clams or oysters are sweet tasting, fat (feed more efficiently and have greater bulk when shucked) and safer to eat raw. This feed can be used to purges some natural phytoplankton that can impart a bitter after taste. This feed binds the naturally occurring

bacteria and very small planktonton into larger flocs by meams of the soup's mucus net such that the bacteria and nanoplankton become captured and digested by the shellfish. The role of seaweed exudate was functionally decomposed and reconstructed as a product by the process of Claim 0.

CLAIM 14. I claim as my invention the addition of **calcium to seaweed** soup to increase its gel strength and solidify it so that it can be a slow release food for aquatic life that has enhanced palatability and antibacterial benefits. The role of calcium binding by fractions of seaweed exudate was functionally decomposed and reconstructed as a product by the process of Claim 0.

CLAIM 15. I claim as my invention a fermented food for feeding shellfish that is made from a soup made from cooked seaweeds that is inoculated with a selection of naturally occurring probiotic bacteria. This fermented food is useful for conditioning shellfish for breeding and for market as it fattens them and quantitatively overwhelms deleterious bacteria such that they are purged and their niches occupied by the probiotic bacteria in the food. The mucus net formed by the sulfated polysaccharides from the rendered seaweed bundle the bacterial so that the shellfish may capture the bacteria and feed on them. The mucus net assisted feeding on bacteria also assists with the purging of potentially deleterious bacteria by enabling the shellfish to excrete them in psuedofeces and/or digest them. The natural interplay of seaweed exudates, bacteria, and shellfish was functionally decomposed and reconstructed as this product by the process of Claim 0.

CLAIM 16. I claim as my invention a shellfish growing device, the marsupium. The mesh-paneled container has more area for exiting water than for entering water so that flow-thru may be sufficient to support a high density of larvae without having the larvae pinned to the exit port mesh. (See Figure 18) This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly

mussel. Additionally this device emulates the marsupium of larvipaous (ovolarviparous) shellfish. These evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 17. I claim as my invention a snag resistant device to resuspend sediment settling on shellfish beds. The device is a swept wing foil on runners towed on the estuary bottom such that sediment lifting vortices are efficiently created. The device will have no load distributing bridle so it may pivot on its tow point in order that it may better escape snags. See Figure 14 The process/device gives humans the ability to emulate ways in which weather and marine life reworks fine sediment in ways that are advantageous to the shellfish's health and prosperity. That arbitrage of conditions over evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 18. I claim as my invention the process of using shellfish culture to provide cost effective and ecologically advantageous infrastructure benefits to marine landforms: Beaches may be enhanced by using this culture to build the beach foreshore. Shorelines and anchorages may be protected by using this culture to build protective bars, bottom reenfocements and environmentally advantageous groins . See Figure 19 The process/devices is a terra-forming product of the integrated system of shellfish production. The process/device is only cost effective within the context provided by the orders of magnitude increase in hatchery productivity within this "Integrated System of Shellfish Production". The economic niche for the device/process of these claims was declared by the marginal cost and constraint analysis of the design paradigm of Claim 0.

CLAIM 19. I claim as my invention the process of using shellfish polyculture to provide a cost effective and ecologically advantageous means of channel building and/or stabilization. This is accomplished by using this culture to 1) build and stabilize marine landforms adjacent to the channel so as to enhance channel scour, 2) using BUPSY shellfish culture to increase scour and/or hydraulic roughness at strategic points, and/or 3) using shellfish to armor an eroding

channel side or bottom. The process/devices is a terra-forming product of the integrated system of shellfish production. The process/device is only cost effective within the context provided by the orders of magnitude increase in hatchery productivity within this "Integrated System of Shellfish Production". The economic niche for the device/process of these claims was declared by the marginal cost analysis and constraint of the design paradigm of Claim 0.

CLAIM 20. I claim as my invention the porous lime (calcium carbonate, dolomite, shell hash, etc.) embedded anode used in the electrolytic pH raising (sweetening) of (acidic) water. The process device of Claim 20 would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

CLAIM 21. I claim as my invention the cavitation suppressing marine propeller nozzle that uses the extension of the upper portion of the propeller nozzle or shroud. See Figure 9 This devices is useful in the implementation of the device of claim 33 and the devices design is the product of the design process in claim 0.

CLAIM 22. I claim as my invention an aquaculture breeding selection by challenge process useful in the selection of progeny with innate immune competencies that are not c-lectin dependant. The process consists of creating conditions of relative base depletion so that the calcium ion dependant c-lectin functionality will be impaired. The process places the progeny in a flow through containment in natural waters so that the progeny might be exposed to a normally wide range of potential pathogens; Naturally occurring potential pathogen carriers may be seeded in the inflowing water as well. The water flowing into that containment is locally acidified and base ion depleted by means of reversed cathodic protection. On a per challenged individual basis, it is many orders of magnitude cheaper to select by challenging recently hatched progeny than it is to select by challenging adults.The process device of Claim 20 would have been easily missed were it not for the discipline of the design algorithm of Claim 0. The design only has utility given the large increase in spawning capacitiy and lowered marginal cost of the "Integrated System of Shellfish Production"

CLAIM 23. I claim as my invention a permanent (or disposable) mooring and aquaculture anchor with exceptionally high holding power and low weight and cost that has the general shape and function of a detachable harpoon point and is harpooned into the bottom with a wash-pipe. See Figure 10 This devices is useful in the implementation of the device of claim 33. This device design was inspired by the mangrove tree propagule and the stinging nettles nematocyst. Those evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 24. I claim as my invention the process of sprinkler irrigating intertidal shellfish when on the low tide the shellfish would be damaged by hot or cold weather or seabird excreta were it not for the moderating effect of the irrigation. This new process is particularly significant in that it markedly enhances the economics of "finishing" deepwater grown shellfish in inter-tidal locations so that shelf-life and marketability will be enhanced. This new process is also significant in enhancing the economics of using intertidal 'hardening' of nursery-stock shellfish

so that they will resist polydora (mud worm) infestation. The Claim 24 process/device gives humans the ability to utilize ways in which the benefits of shellfish exposure to atmospheric exposure may be had while avoiding the detriments of atmospheric exposure. This arbitrage of conditions was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 25. I claim as my invention a grow-your-own clam predator exclusion net made from the subaquatic vegetation or seaweed that can replace the high cost, high maintenance, high smoother risk, politically vulnerable, plastic clam predator exclusion net. This process/device would have been easily missed were it not for the discipline of the design algorithm of Claim 0. The design only has utility given the large increase in spawning capacitiy and lowered marginal cost of the "Integrated System of Shellfish Production" where higher lose rates are economically acceptable.

CLAIM 26. I claim as my invention the shellfish polyculture device of using clam predator exclusion net to raise oysters on top of the net in addition to raising clams under the net. This process/device would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

CLAIM 27. I claim as my invention a process of enhanced cultivation of aquatic vegetation such as Spartina sp. And Zostera sp. by the use of shellfish polyculture to supply the vegetation with fertilizer by means of shellfish excreta. This process/device would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

CLAIM 28. I claim as my invention the crustacean:mollusc polyculture device of using clam predator exclusion net to raise crustaceans like shrimp in combination with molluscs like clams and oysters. This invention is an expansion of customary usage of clam predator exclusion net in which a single "story" clam culture is expanded to a three "story" culture with the crusetaceans penned in the middle within predator exclusion mesh and molluscs above and below the shrimp

providing food for the shrimp by means of their excretia and the shrimp providing hygene services for the mollusks. This process/device was declare by the constraint management discipline and design process of Claim 0.

CLAIM 29. I claim as my invention a process of enhancing the cultivation of shellfish by the use of macroalgae and sub-aquatic vegetation (SAV) such as Zostera mariana to supply the shellfish with beneficial Dissolved Organic Matter (DOM), enhanced immune and shell building water chemistry, enhanced phytoplankton production and enhanced phytoplankton and bacterioplankton capture. The interplay of seaweed exudates, bacterioplankton , and shellfish was functionally decomposed and reconstructed this cultural process by the design process of Claim 0.

CLAIM 30. I claim as my invention the use of a horizontal mesh, like clam predator exclusion mesh, to anchor and cultivate marsh grass and a rooted sub-aquatic vegatation (SAV) such as Zostera mariana. This process/device would have been easily missed were it not for the discipline of the design algorithm of Claim 0.

CLAIM 31. I claim as my invention **panels** for constructing a shellfish growing device. These shellfish culture device panels are open frames, approximating a plane, and covered with a disposable impermeable envelope. This envelope will intentionally tear in storm conditions so that further damage can be minimized. The envelope is shed to clear bio-fouling when needed. This process/device emulates the various configurations of and benefits derived from fish gill parasitism in the glocidian nursery strategy of the freshwater pearly mussel. This evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 32. I claim as my invention a floating shellfish growing device (**the Spawntoon assembly**) consisting of two classes of pontoon assemblies, a heavier class and a lighter class. The heavier of the pontoon assemblies may be the lifting and maintenance assembly. The lighter assembly flanks the heavier. The lighter assembly consists of a pontoon with breasting spars. One end of the spar is affixed to the light pontoon and held in breasting position. The other end of the breasting spar is attached to the heavier pontoon assembly so that the lighter pontoon assembly may bob freely on the waves. Dividing the pontoon support into these two assemblies and providing this particular flexible coupling between them is the essence of the utility in this invention claim. (**Figure 6**) This devices is useful in the implementation of the device of claim 33. The design was inspired by an egg raft that was probably produced by the marsh grass snail, *Littorina irrorata.* Those evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 33. I claim as my invention a water supported live well consisting of 1) an impermeable membrane attached to the rim which bounds the well's contents from the supporting water; and 2) a top rim, ridged enough to establish a consistent elevation of that rim (possibly with the aid of floatation in the rim), to maintain separation between the liquid contents of the well and the liquid supporting the well and supply lifting points. See Figure 8 This device within the Integrated System that emulates the marsupium of larvipaous (ovolarviparous) shellfish. That evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 34. I claim as my invention a larval capture and draining device used to retain the spawn when a floating hatchery live well is drained by lifting or floatation such that the water is removed near the surface of the water containment even as that water level changes and that the larvae are captured at the inlet of the draining device rather than at the outlet as in the prior practice. This new device makes the water supported live well practical in larvaculture. See Figure 8, Figure 5 The device of Claim 34's design was inspired by the 'rafting' behavior sometimes displayed by planktonic shellfish veligars in which the veligars appear to act as a

school and form a vortex by their concerted motion that appears to act as a pump so that they might harvest more plankton from more water than the could achieve by individual action alone. The action also causes the 'raft' to hug the surface of the water when the larvae are so heavy that they would other wise sink to the bottom in a location that might be less than desirable due to the conditions previously mentioned. That evolutionary and biological strategy was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 35. I claim as my invention a movable stretcher to both support a horizontal algae culture bag over a span, and to provide shade to the spanned region. See **Figure 7** This devices is useful in the implementation of the device of claim 33 and the devices design is the product of the process in claim 0. .

CLAIM 36. I claim as my invention a wave agitated floating platform for the agitation and support of phytoplankton/microbiological culture. See Figure 7 This devices is useful in the implementation of the device of claim 33 and the devices design is the product of the process in claim 0.

CLAIM 37. I claim as my invention the process of mitigating the acid and anoxia formed in the inevitable process of resuspending of estuarine sediments having a high chemical oxygen demand. Relatively frequent, small, directional, resuspensions of small impact are desirable rather than the catastropphic resuspensions or the randomly directed resuspensions that are more likely to occur in the unmanaged course of nature, unless of course, those natural events are preempted with intentional resuspension and capture. This process/device allow humans to emulate ways in which shellfish modify their environment so that the shellfish become even more prosperous and resilient to misfortunes of weather. These evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 38. I claim as my invention the amendment of estuary bottom sediments with marl or shell to aid in the sequestration and mitigation of toxic and/or sulfide rich estuarine sediments in order that bottom that was previously unproductive and relatively barren be restored to vigorous health, biotic diversity and shellfish productivity. Under the influence of this ammendment all subsequent resuspensions of the sediment are less caustic, less heavy metal noxious, and less detrimental to shell stock and calcium availability dependant immune competencies since the sulfide:carbonate ratio of the sediment is more to the carbonate. This process/device allows humans to emulate ways in which shellfish modify their environment so that the shellfish become even more prosperous and resilient to misfortunes of weather. These evolutionary and biological strategies were functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.

CLAIM 39. I claim as my invention a new use and a 'Best Practice' process in the development and management of low flow estuarine canals in a water front real estate development where the liveliness and productivity of the channel is promoted, sedimentation is locally eliminated, stinging nettles are suppressed, phytoplankton diversity enhanced and hazardous dynoflagelate blooms suppressed and the canal turned into a highly productive area for shellfish reproduction. This process is effected by the release of air bubbles from the bottom of the channel such that it creates a continual upwelling and current. This process/device allow humans to take environments in which shellfish have transients of prosperity and modify that environment so that the shellfish prosperity is more continuous and less subject to misfortunes of weather. This arbitrage of conditions was functionally decomposed and reconstructed as a human implementable design by the process of Claim 0.